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- (21) Application No. 23592/72 (22) Filed 19 May 1972  
 (31) Convention Application No. 2 125 117  
 (32) Filed 21 May 1971 in  
 (33) Germany (DT)  
 (44) Complete Specification published 12 Feb. 1975  
 (51) INT CL<sup>7</sup> F16J 15/52  
 (52) Index at acceptance  
     F2B 13C3 13X2  
     F2T HX3



## (54) IMPROVEMENTS IN AND RELATING TO BELLOWS

(71) We, ROBERT BOSCH GMBH, a German Company, of Postfach 50, 7 Stuttgart 1, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a bellows for enclosing a space traversed by a piston rod at the rear of a working cylinder.

A conventional bellows has the disadvantage that, while it provides protection from dust and dirt, water can penetrate into a number of air holes in a fold of the bellows and thence to the rear end of the working cylinder. The functioning of the working cylinder may thereby be impaired, especially in winter, when the intruding water freezes.

The present invention seeks to substantially eliminate this disadvantage and to provide a bellows of the type initially described which will prevent the ingress not only of dust and dirt but also of water into the working cylinder.

According to the present invention there is provided a bellows for enclosing a space traversed by a piston rod at the rear end of a working cylinder, having a large end portion for attachment to a cylindrical body of the working cylinder, a small end portion for embracing the piston rod, a number of air holes in a fold of the bellows and a protective dust filter for covering the air holes, at least the fold of the bellows section embodying the air holes being engageable by a cover which is coaxial with the bellows and is open at one of its ends to the surrounding air, the cover retaining the filter in contact with the air holes.

The invention will be described further, by way of example, with reference to the accompanying drawings, in which:—

Fig. 1 is a bellows ready for installation 45 having a filter in position,

Fig. 2 is the bellows compressed during operation, and

Fig. 3 is a further embodiment of the bellows.

A bellows 1 is designed to enclose a space traversed by a piston rod at the rear of a working cylinder. The bellows 1 has a large end 2 for attachment to a cylindrical body of the working cylinder and a small end 3 embracing the piston rod. Towards the small end 3 of the bellows 1 there are three folds 5, 6 and 7 of small diameter, and towards the large end 2 there are three folds 8, 9 and 10 of large diameter.

In the outer wall of the first fold 5 facing the smaller end 3 eight air holes 11 are uniformly arranged on a pitch line. The exterior of the outer wall is formed into an annular lip 12 around each hole 11, the significance of which lip will be explained hereinafter.

Formed on the small end 3 of the bellows 1 remote from the working cylinder and perpendicular to the axis of the bellows is a supporting wall 13 of a cover 14 having externally a retaining wall 15 which is substantially coaxial with the bellows and which is open at the end opposite the wall 13. The retaining wall 15 has eight clips 16 which engage over the first fold 5 of the bellows 1 and also eight ribs 17 arranged axially, which engage the outside diameter of the first fold 5 and permit the passage of air. Between the first fold 5 and the cover 14 an annular chamber 18 is formed, into which an annular filter 19 serving as a dust guard is inserted. The cover 14 retains the filter 19 in contact with the air holes 11 by means of the supporting wall 13 and the retaining wall 15. The internal and external surfaces of the retaining wall 15 of the cover 14 are outwardly frusto-conical in the direction of the

open end thereof; it is possible, however, for the internal surface only to be frusto-conical.

5 The first fold 5 of the bellows 1 is reinforced at least at its apex 5' in order to render the fold 5 sufficiently dimensionally stable with respect to the clips 16 and the ribs 17. The end of the clips 16 facing the second fold 6 are chamfered to conform to the shape of the second fold 6.

10 Fig. 3 shows a bellows 21, in which a cover 14' is arranged on the larger end 2' and air holes 11' and a filter 19' are provided on the large fold 10. In other respects the embodiment illustrated in Fig. 3 corresponds to that shown in Fig. 1.

15 During the backward-and-forward movement of the piston rod to which the small end 3 of the bellows 1 is secured the bellows first assumes the extended form shown in Fig. 1 and then the compressed form shown in Fig. 2. It may also be seen from Fig. 2 that the first two smaller folds 5, 6 are able to retract into the cover 14.

25 On extension and compression of the bellows the difference in volume in the working cylinder is compensated via the air holes 11. The dust contained in the air passing through is retained by the filter 19.

30 Penetration of water into the bellows is prevented in the following manner:

35 The mean cross-sectional area of the eight air holes 11 and of the pores of the filter 19 is so adjusted that the velocity of the air passing through them is reduced to a minimum. This ensures that the air does not induce any rain or static water which may reach the vicinity of the bellows. The filter 19 forms, together with the air holes 11 and annular lip 12 a labyrinth which prevents water from reaching the inner chamber of the bellows. Water which, for example, enters the filter 19 in atomised form runs down out of the filter 19, and water which reaches the outer wall of the first fold 5 runs off the latter and the annular lip 12. Any water passes to the lower region of the inclined inner surface of the retaining wall 15 and thence flows to the outside along the ribs 17.

50 Owing to its axially symmetrical design the bellows has the advantage of being capable of installation in any position of its longitudinal axis.

55 **WHAT WE CLAIM IS:—**

1. A bellows for enclosing a space traversed by a piston rod at the rear end of a working cylinder, having a large end portion for attachment to a cylindrical body of the

working cylinder, a small end portion for embracing the piston rod, a number of air holes in a fold of the bellows and a protective dust filter for covering the air holes, at least the fold of the bellows section embodying the air holes being engageable by a cover which is coaxial with the bellows and which is open at one of its ends to the surrounding air, the cover retaining the filter in contact with the air holes.

2. A bellows as claimed in claim 1, in which the fold which is engaged by the cover is an end fold of the bellows.

3. A bellows as claimed in claim 1 or 2, in which the cover is connected to an end portion of the bellows and so that the opening thereof faces towards the folds of the bellows.

4. A bellows as claimed in any of claims 1 to 3 in which at least the inner surface of the cover is frusto-conical and of increasing radius towards its opening.

5. A bellows as claimed in any of claims 1 to 4, in which the cover has a supporting wall disposed substantially perpendicularly to the axis of the bellows being attachable to the bellows and an axially disposed retaining wall.

6. A bellows as claimed in claim 5 in which the retaining wall has a number of clips for engaging over the fold of the bellows embodying the air holes and a number of axially disposed ribs for engaging the outside diameter of the fold for the passage of air.

7. A bellows as claimed in claim 6, in which the first fold of the bellows section serving to engage the clips and the ribs is reinforced at least at its apex.

8. A bellows as claimed in claim 6 or 7, in which the ends of the clips are chamfered to conform to the shape of the adjoining fold.

9. A bellows as claimed in any of claims 1 to 8 in which the exterior of each air hole is surrounded by an annular lip.

10. A bellows as claimed in any of claims 1 to 9, in which the bellows is axially symmetrical.

11. A bellows as claimed in any of claims 1 to 10, in which the mean cross-sectional area of the air holes and of the pores of the filter is such that the velocity of the air flowing through the same is reduced to the extent that water does not enter the bellows.

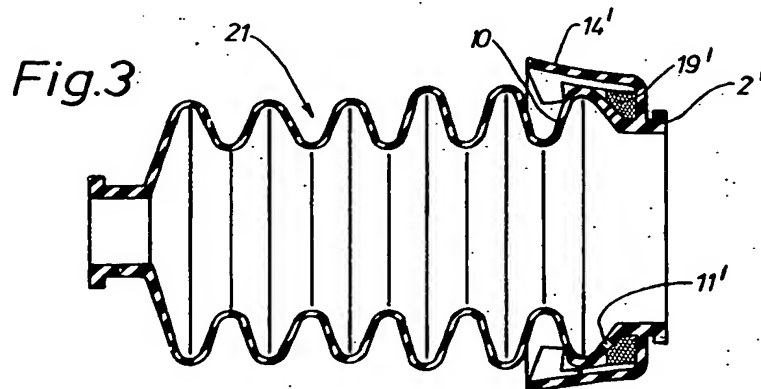
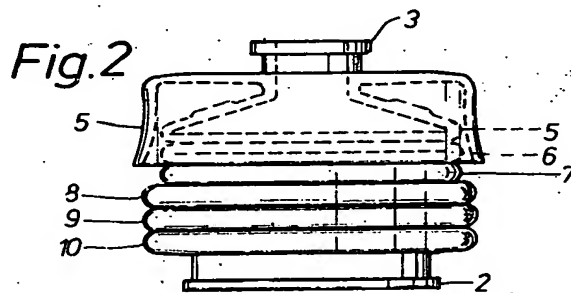
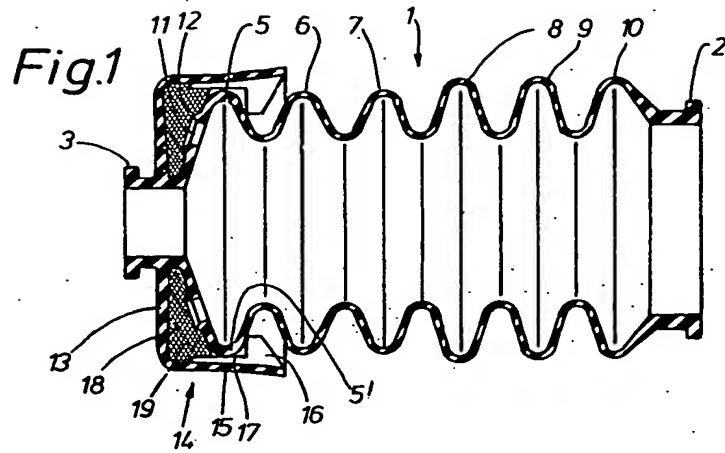
12. A bellows constructed, arranged and adapted to be used substantially as hereinbefore particularly described with reference to and as illustrated in Figs. 1 to 2, and Fig. 3 of the accompanying drawings.

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Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1975.  
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from  
which copies may be obtained.

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